final report

I-67 Corridor Feasibility Study

prepared for

I-67 Development Corporation

prepared by

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Executive Summary

The I-67 Development Corporation (the Corporation) is interested in developing a limited access highway corridor between I-65 in Nashville, Tennessee and I-196 in Western Michigan. While portions of the subject corridor have recently been upgraded, or are under study for possible upgrades, the Corporation is primarily interested in the portion of the corridor between I-65, near Bowling Green, Kentucky and Indianapolis, Indiana.

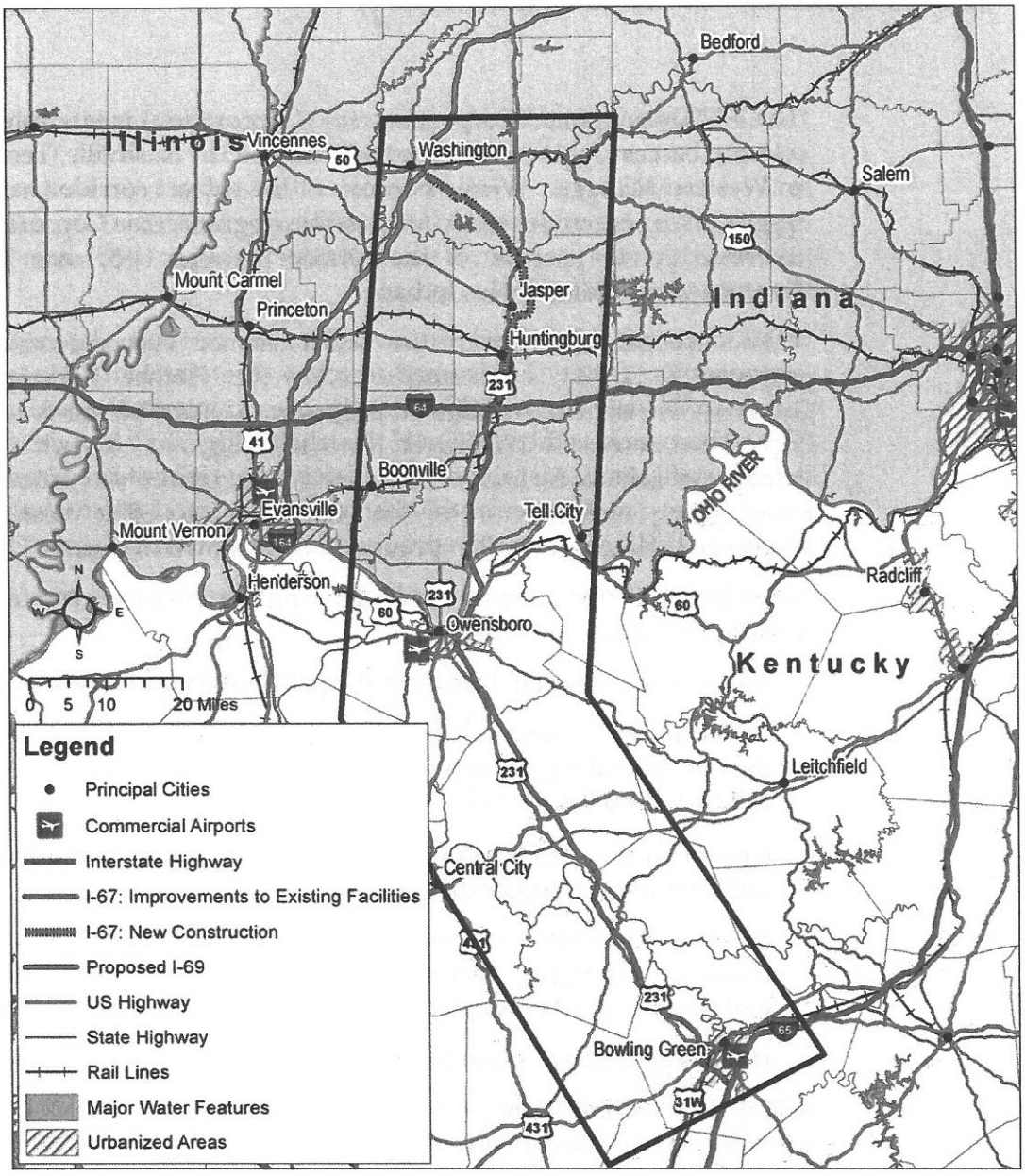
While a specific alignment for the facility has not been determined, for analysis purposes the facility is assumed to follow the Natcher Parkway from Bowling Green to Owensboro, with limited upgrades to Interstate standards; US-231 from Owensboro, across the William H. Natcher Bridge, to I-64, with limited upgrades to Interstate standards; and on completely new right-of-way from I-64, bypassing Huntingburg and Jasper to the east, and tying into I-69 at Washington, Indiana. A potential alignment for the proposed I-67 is shown in Figure E.1.

To assist the Corporation in understanding the business case for the proposed corridor, this study includes:

- stakeholder outreach, including the public and private sector;
- travel demand forecasts to determine potential traffic volumes for I-67 and the corresponding impacts on competing roadways based on both tolled and toll-free scenarios for I-67;
- current traffic safety conditions in the region and the corridor specifically, with estimated changes due to I-67;
- an economic impact analysis consisting of a profile of the economy of the corridor, a strengths, weaknesses, opportunities and threats (SWOT) analysis, and the potential economic impacts of the development of I-67; and
- recommendations for implementation and next steps.

I-67, if built without tolls, is expected to attract anywhere from 16,000 to 30,000 vehicles per day along most of its length in 2035, with the highest volumes toward the central and southern ends of the corridor (Table E.1). It provides some diversion not only from parallel arterials (such as US-231) for trips to, from, and within the corridor, but also diverts some longer-distance traffic from I-65, providing some congestion relief in that corridor. I-67 is not expected to divert traffic from I-69, but rather complement it, by increasing demand on the facility north of Washington, IN.

Figure E.1 Proposed I-67: Potential Alignment



Data Source: National Transportation Atlas Databases 2012.

To estimate the travel efficiencies associated with the highway improvement, the daily changes in vehicle-miles and vehicle-hours traveled from the travel demand model are estimated, annualized and monetized to determine the net benefit or travel efficiency gains in five areas between the build (toll and toll-free) and no-build scenarios: travel time, reliability, vehicle operating costs, safety, and emissions.

To estimate the economic impact of the investments, these travel efficiency gains are mapped to households or industry, depending on the beneficiary. Estimated changes in those classified as "explicit costs" serve as input into the IMPLAN input/output economic model to estimate economic impacts. The output from the IMPLAN model is expressed as changes in employment, output, and value added. These accrue as direct (impacts associated with roadway capacity improvements that are the direct effects of changes in output or production cost, and spending in key economic industries); indirect (increased demand for key input materials by local firms who are the direct suppliers to these "direct" businesses); and induced (changes in household consumption of goods and services from "direct" and "induced" benefactors) impacts.

Through the transportation cost savings experienced by users in the corridor, $2.4 billion is expected in benefits for households and businesses over 20 years, based on the toll-free build scenario. These benefits increase to $3.2 billion for all of southern Indiana and central Kentucky, also for the toll-free build scenario. Tolls provide some revenue but also decrease demand and usage on the facility, and therefore decrease transportation benefits of the facility. $1.1 billion is expected in benefits for households and businesses in the eight-county study area over 20 years when tolls are added, or $1.8 billion across southern Indiana and central Kentucky.

These transportation benefits to households and industry translate into direct economic impacts in the form of increased industry output and additional job creation. These direct impacts, in turn, ripple through the economy in the form of indirect and induced economic impacts. Based on the toll-free build scenario, total increased combined economic output over 20 years due to these impacts from I-67 are expected to reach $1.3 billion in the corridor, with over 10,000 new job-years created. With tolls, $430 million in economic output 3,610 new job-years are expected.

With the highly skilled labor force, available land, productive local industry in the form of manufacturing and power generation, diverse intermodal transportation options, and affordable and available housing, the region would benefit in the form of growth of existing businesses and increased business attraction. Numerous industries have identified supply chains that rely on highway transportation, whose costs would be reduced by improvements in the corridor. Highway access, and particularly Interstate access, is known to be a key factor in business location decisions.

Several next steps are recommended based on typical progression of highway corridor projects as well as issues specific to the study corridor:

- Further analysis of financial feasibility and funding options.
- Consideration of phasing.
- Concurrence to proceed with developing the I-67 Corridor between the States of Indiana and Kentucky.

- NEPA Studies.
- Corridor Preservation.
- Preliminary Design and Final Design.
- Right-of-way Acquisition and Construction.

Table E.1 Summary of I-67 Impacts

	Build Without Toll Scenario	Build With Toll Scenario
I-67 Travel Volumes (Daily)		
KY	24,900 – 32,000	21,200 – 28,500
IN	14,200 – 24,900	9,600 – 22,200
Percent Reduction in (and Number of) Regional Average Annual Crashes		
Fatalities	-0.2% (-2)	-0.1% (-1)
Injuries	-0.5% (-320)	-0.3% (-175)
Property Damage Only	-0.5% (-590)	-0.3% (-340)
Monetized Transportation Benefits, 8-County Study Area (20-Year NPV, Millions US$, 2012)		
Travel Time & Reliability	1,362.9	755.0
Vehicle Operating Cost	-416.4	-404.1
Safety Cost	1,439.2	717.0
Emission Cost	-20.0	-4.7
Total Transportation Benefits	2,365.9	1,063.2
Monetized Transportation Benefits, Entire Model Area (20-Year NPV, Millions US$, 2012)		
Travel Time & Reliability	1,659.6	924.0
Vehicle Operating Cost	-147.9	-23.7
Safety Cost	1,767.6	949.7
Emission Cost	-6.2	-2.7
Total Transportation Benefits	3,272.8	1,847.3
Economic Impacts, 8-County Study Area (20-Year NPV)		
Job-Years	10,830	3,610
GRP (Millions US$)	673.5	230.5
Output (Millions US$)	1,329.5	460.5
Toll Revenue (20-Year NPV, Millions US$, 2012)		
	N/A	43.7

Source: Cambridge Systematics Analysis

1.0 Introduction

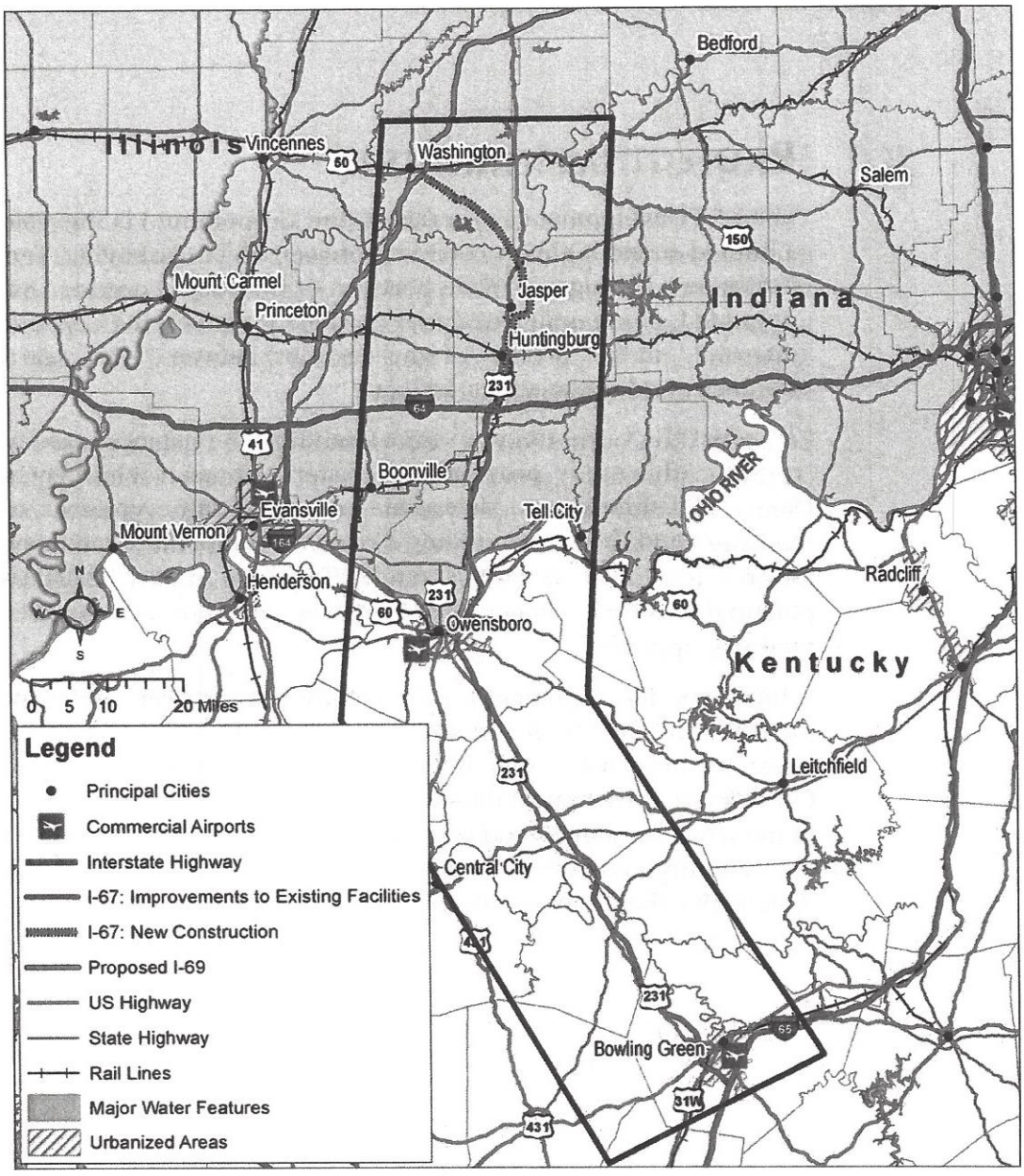
1.1 Project Background

The I-67 Development Corporation (the Corporation) is interested in developing a limited access highway corridor between I-65 in Nashville, Tennessee and I-196 in Western Michigan. While portions of the subject corridor have recently been upgraded, or are under study for possible upgrades, the Corporation is primarily interested in the portion of the corridor between I-65, near Bowling Green, Kentucky and Indianapolis, Indiana.

To assist the Corporation in understanding the business case for the proposed corridor, this study provides a two-step approach which includes: 1.) Travel Demand Estimation to determine potential traffic volumes on the upgraded roadway and the corresponding impacts on competing roadways, based on both toll-free and tolled scenarios; and 2.) Economic Impact Analysis to identify the potential economic benefits that might be expected as a result of the proposed roadway upgrade.

While a specific alignment for the facility has not been determined, for analysis purposes the facility is assumed to follow the Natcher Parkway from Bowling Green to Owensboro, with limited upgrades to Interstate standards; US-231 from Owensboro, across the William H. Natcher Bridge, to I-64, with limited upgrades to Interstate standards; and on completely new right-of-way from I-64, bypassing Huntingburg and Jasper to the east, and tying into I-69 at Washington, Indiana. A potential alignment for the proposed I-67 is shown in Figure 1.1.

Figure 1.1 Proposed I-67: Potential Alignment



Data Source: National Transportation Atlas Databases 2012.

1.2 Report Organization

The remaining sections of this report are organized as follows: Section 2 provides a high level summary of the stakeholder outreach conducted in the region, early in the study process. Section 3 describes the technical methodology used to develop and validate the travel demand model, and presents the

resulting travel demand forecasts. Using these data and local crash information, an analysis of the current safety conditions in the region and the corridor specifically is presented in Section 4. The economic impact analysis in Section 5, which incorporates the information from Sections 2 through 4 in addition to other economic indicators, presents a profile of the economy of the corridor and the potential economic impacts of the development of I-67. The results are summarized in Section 6, with recommendations for implementation and next steps in Section 7.

2.0 Stakeholder Outreach

This section summarizes the results of a series of stakeholder interviews conducted during March and April, 2012 both in person and by phone. The purpose of the interviews was to provide insight into the potential impacts and opportunities of the proposed infrastructure enhancements at both the regional and national levels. These insights help to better target the assessment of the business case for the proposed infrastructure investments.

Key issues raised during the interviews are organized below by key topic. Important overall issues included:

- This region, encompassing south-central Indiana and western Kentucky, has a strong economic base, a dedicated workforce, and low levels of unemployment. The addition of I-67 could help ensure continued economic success for the region.
- One current weakness identified in the area is the lack of a north-south route in the Indiana portion of the study corridor. The current north-south route, US-231, faces congestion and safety issues including narrow lanes, conflicts with local traffic, limited sight distance, and lack of shoulders in some areas.
- Tolling would most likely be an acceptable funding mechanism, with a history of toll roads in Kentucky and businesses that would generally be amenable to tolling given the economic savings that they would receive in return.

Interviewees included:

- Mayor Denny Spinner, City of Huntingburg
- Mayor Ron Payne, City of Owensboro
- Mayor Terry Seitz, City of Jasper
- Mayor Joe Wellman, City of Washington
- Hank Menke, OFS Brands
- John DiDomizio, Morley & Associates
- Ron Arnold, Daviess County (IN) Growth Council
- Debbie Benedek, Greater Owensboro Chamber of Commerce
- Nick Brake, Greater Owensboro Economic Development Corporation
- Mike Braun, Meyer Distribution
- Jim Dinkle, Dubois County Area Development Corporation
- David Holt, Conexus Indiana

- Dan Koch, Holiday World
- Travis McQueen, Dubois County Airport
- Ken Mulzer, Mulzer Stone
- Greg Stoner, MasterBrand Cabinets
- Tom Utter, Lincolnland Economic Development Corporation

2.1 STRONG ECONOMIC BASE

South-central Indiana and Western Kentucky foster a variety of industries. Of the many industries highlighted by the stakeholders, furniture and wood products were generally at the top of the interviewees' lists. Dubois County, Indiana is home to a number of furniture manufacturers including Kimball, OFS, and Masterbrand.

Also mentioned frequently during the interviews were agriculture and food processing industries. Far Best Turkey Farm in Huntingburg, IN, is a major employer and shipper of processed turkey. Far Best has announced a new facility for Vincennes, IN, in Knox County. Perdue Foods also has a turkey processing plant in Washington, IN. In addition, the region has a significant amount of grain processing, particularly along the Ohio River. Owensboro, KY is home to a number of food manufacturing industries. A one-billion dollar nitrogen fertilizer plant has also been proposed in the corridor in either Spencer County or Owensboro. The plant would heavily depend on highway access for delivery of fertilizer products.

The automotive industry also has a presence in the region. Toyota (located west of the study area in Princeton, IN), General Motors in Bowling Green, KY, Jasper Engines and Transmissions, a large corporation that remanufactures drive train components, and an automotive parts supplier in Owensboro, KY are prominent regional employers in this industry.

The United States Navy employs a number of people at the Crane Naval Service Warfare Center. Nearby, a large new office park and employment center called the WestGate Technology Park houses engineering firms that largely support the military. WestGate's first building opened in 2008 and roughly 500 people worked there around the time of the interviews, mainly in the engineering, electronics, and radar sectors.

Mining and energy-related industries are also prevalent in the region. While much of the coal that is mined in southern Indiana is less desirable "soft" coal, the upcoming installation of scrubbers at the AEP coal-based power plant in Spencer County may result in more of the region's coal being used locally. A coal gasification plant, currently being negotiated in Spencer County, would use 3.5 million tons of coal per year, and create 200 permanent - and 1000 construction - jobs. Southern Indiana is also home to a number of limestone quarries.

Several prominent health care facilities are located in the region. Memorial Hospital, located in Jasper, Indiana is currently a major employer. In addition, an extensive medical complex is currently nearing completion on the east side of Owensboro, KY, in close proximity to the US 231 corridor. This $450M complex will also be a major employer for the region.

The area's tourism and hospitality industry is growing, consisting of amusement parks such as Holiday World and Splashin' Safari in Santa Claus, IN, which attract more than 1 million visitors per year and may have as many as 2 million per year by 2020. Upcoming projects include a 60,000 square foot conference and training center near Crane scheduled to open in the fall. In addition, the City of Owensboro currently has a major redevelopment project underway along the riverfront which will include a convention center, two new hotels, a playground, residential developments, Riverpark Center and other planned developments for the future. An International Bluegrass Center is proposed for the former State Office Building in Owensboro.

The region is doing well, despite the ailing global economy. A number of stakeholders highlighted the $12 million Battery Innovation Center, a research facility scheduled to be completed at the end of the year. This could be a great asset to the region. One stakeholder mentioned the possibility of "spinoffs" from this research facility or the possibility of a graduate degree program that could partner with Cummins and Delphi. While the region supports a number of industries, a few stakeholders believe that it could benefit from greater diversity, especially the addition of the warehousing and logistics and tech industries.

The low unemployment in the region (among the lowest in the State of Indiana) was cited by many stakeholders. The fact that despite a major economic downturn, the unemployment rate remains the lowest in the state illustrates the ability of this region to "weather the economic storm" better than other regions. Another fact cited by stakeholders was the region's drawing workers from seven surrounding counties.

The region's strong work ethic was cited by almost all interviewees as one of its greatest strengths. Many referred to the area's history as a farming and woodworking community as one of the reasons this ethic has been carried forward to today. However, while the employment base is strong, the need for a better trained workforce was cited as an area for improvement.

2.2 Population and Employment Growth

Many individual communities and the region as a whole are projecting population growth. One stakeholder noted an increase in retirees in recent years. Others discussed the desire for a larger population of young families. Some referenced the problem of "brain drain", referring to the pattern of young adults leaving the area to advance their education outside the region and not returning. A younger population was seen as advantageous for cultural and economic

development of the region. The need for a better-trained workforce was cited earlier; the critical issue was seen as the need to attract that workforce to the region. Some attractors could be good jobs with generous wages, high quality of life and low cost of living, and access to amenities.

Among the region's strengths is its low cost of living. However, some stakeholders mentioned that wages are low in the region. There has been some recent positive press about Owensboro, Kentucky. It received the following distinctions: named by *Money Magazine* as one of the top 100 places to live for a small metropolitan area; named by *Forbes* as one of the Top 100 Cities for Business & Careers; and named by *Business Insider* as one of America's next silicon valleys.

In terms of the ability of the region to attract companies and a greater diversity of companies and industries, the notion of the region being "landlocked" was cited by many. The lack of a "north-south" interstate through the region is perceived as a hindrance. It is felt that this sometimes causes employers to overlook the area as a viable location for a corporate headquarters or major center because of this lack of transportation access. While US-231 provides north-south access in the Indiana portion of the study corridor to Indianapolis from points south, the lower speed limit, local traffic and signalized intersections, and the safety and design issues could be perceived as having a negative effect on some businesses.

2.3 TRANSPORTATION INFRASTRUCTURE

The region's strong economic base is supported by good transportation infrastructure; however, there is room for improvement. System highlights include a small airport in Dubois County that caters to corporations. Easy access from corporate headquarters to the small general aviation airport is a major benefit to companies with corporate headquarters in the region. East-west rail lines are also helpful for the movement of goods. While convenient access to rail is important to some businesses, access to Interstate highways is also seen as desirable to many corporations. Additionally, port access along the Ohio River is another strength of the region, particularly to industries such as a stone quarry in the region, for which shipping by barge is the least expensive option.

Stakeholders feel that existing north-south access is insufficient, particularly for companies that rely heavily on efficient goods movement. Concerns about US-231 included congestion and bottlenecks. For businesses that rely on trucks for goods movement, the lower speed limit, congestion through local communities, and narrow roadway design on US-231 cause significant delay. It is much more desirable for a company to have direct access to an Interstate with a 65 mph or 70 mph speed limit. The difference in travel times that could be achieved on an Interstate highway versus a non-Interstate highway could amount to significant cost savings for shippers, companies that rely on freight movement, and workers.

Another important point about this project is its relationship with other transportation projects in the area. This includes the relationship with the proposed I-69 project. These roads were seen by many stakeholders as complementary because I-67 would connect with I-69 and provide a continuous Interstate from south-central Indiana to Indianapolis and beyond. This Interstate would also connect with rail infrastructure and the port along the Ohio River to make this region an intermodal center.

2.4 Freight Movement Challenges and Opportunities

Freight movement is critical to the economy of the study area. The following items were cited as areas in need of improvement:

- US-231 can be congested and has bottlenecks at certain spots, which can be costly to businesses that rely on moving goods quickly between their headquarters and other regions.
- US-231 has a maximum speed limit of 55 mph and 60 mph in Spencer County, with much lower speeds through communities; the difference between 55 mph and 65 or 70 mph is critical in the area of goods movement.
- US-231 also has some safety issues, including narrow lanes, winding and hilly sections, limited sight distance, and the lack of a road shoulder in sections.
- Better connectivity to Indianapolis, Chicago, Nashville, and elsewhere was desired, especially for a number of businesses that serve national and international markets. The proposed I-67 project could help provide this connectivity.

2.5 Benefits and Costs

Most interviewees saw more positive than negative outcomes to the proposed I-67 project. Potential negative outcomes included environmental damage and removal of farmland to make way for the road.

In terms of the economy, most stakeholders cited the addition of I-67 as essential to maintaining and expanding the region's economy; some said that the economy will suffer if this region does not add a north-south Interstate highway in the south-central part of Indiana. A commonly cited theme was that the region must continue to retain and attract businesses.

2.6 Funding Opportunities

In a climate of shrinking budgets, the question of how to fund a major transportation project is an important one. Regarding the idea of tolling as a

means to fund the I-67 project, many stakeholders expect initial pushback, particularly from the local community, but noted that people will eventually begin to accept a new toll road because of the projected economic benefits, as well as the added convenience of the new Interstate. There was general agreement that most industries will support the addition of the I-67 toll road because the expected travel time savings that will be achieved by the trucks moving goods on the new, faster roadway will ultimately result in cost savings.

Familiarity with toll roads and with studies of the corridor in which I-67 would be located are two factors that could make this idea more amenable to stakeholders. Interviewees mentioned that drivers in the region are already familiar with paying tolls on the Natcher Parkway, which runs from Bowling Green to Owensboro, Kentucky, so this proposed toll road would not be an unfamiliar concept. Additionally, reports about improvements in the corridor, in particular the US-231 EIS, have been publicized, so the community is familiar with this topic.

3.0 Travel Demand Forecasts

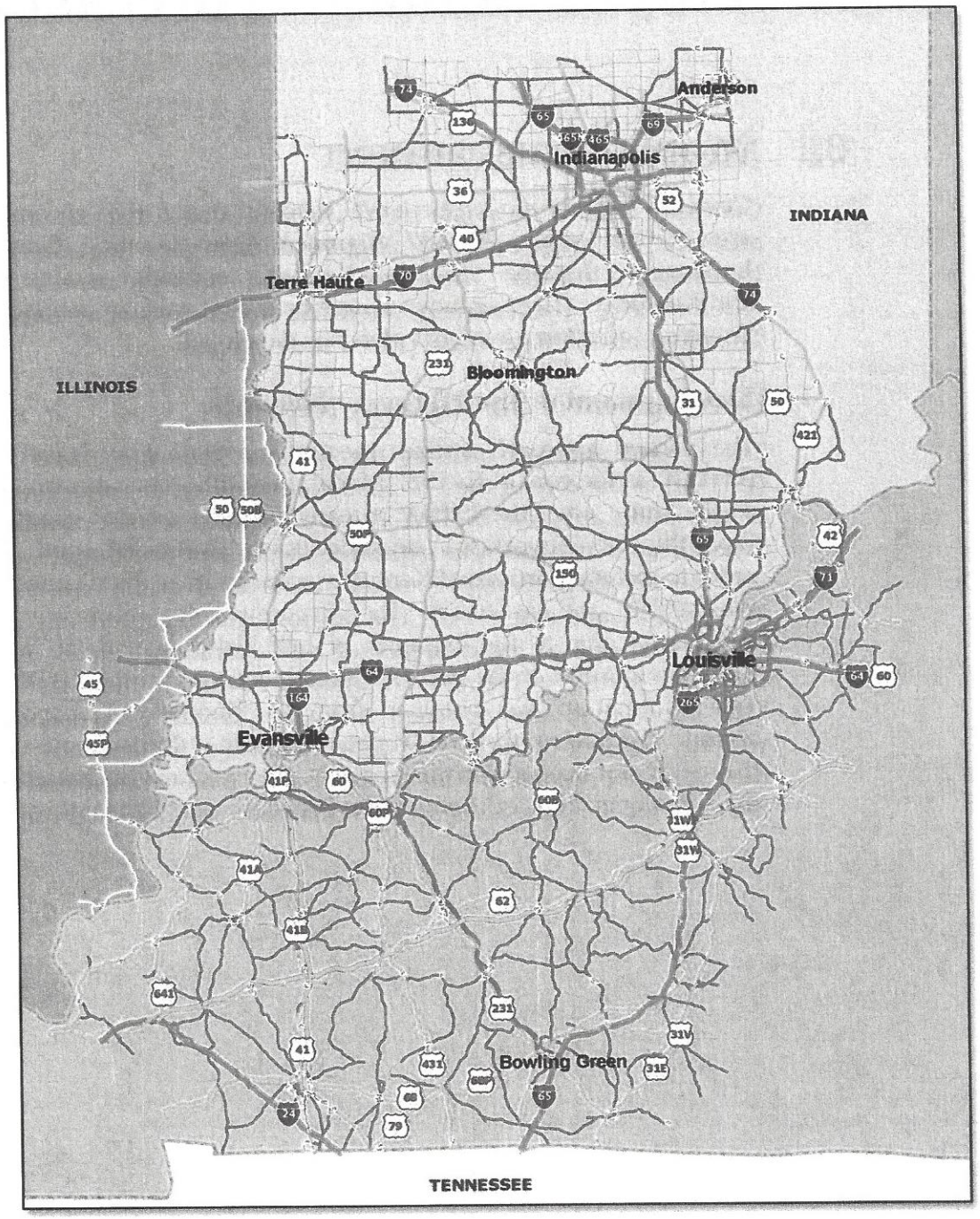
3.1 Model Development

Currently there is no single travel demand model that encompasses the study area for the proposed I-67 alignment from Bowling Green, Kentucky to Indianapolis, Indiana. There are, however, statewide models for both Indiana and Kentucky. The Kentucky statewide model was not available for this study: Therefore, an alternate model plan was developed.

Development of the Highway Network

The revised approach utilizes the Indiana Statewide Travel Demand Model (ISTDM) as the core of the I-67 Model. In addition to capturing the Indiana side of the study area, the ISTDM already includes several counties in Kentucky. From this, the network was expanded to the southwest, south, and southeast in order to include portions of Kentucky as far south as the Tennessee border, as far West as I-24, and east of I-65. The purpose was to capture any traffic that could be diverted due to the existence of I-67. Additional detail was added to the Kentucky portion of the network already existing in the ISTDM model as well. This information was obtained from the Kentucky Transportation Cabinet's website. Sections of the ISTDM network north of Indianapolis were removed as they were not needed for this analysis; their removal increased the efficiency of the I-67 Model. Figure 3.1 shows the final base year 2010 highway network.

Figure 3.1 Study Area Base Highway Network (2010)



Development of Traffic Analysis Zone (TAZ) Layer

Indiana Area

For the Indiana portion of the study area, the ISTDM TAZs were used directly. For the new boundaries where portions of the ISTDM network were removed, new external zones were developed.

Base year 2010 and future year 2035 demographic data contained in the Indiana TAZs include:

- Number of Households and
- Number of Employees by type.[1]

Kentucky Area

For the Kentucky portion of the study area, new TAZs were developed. These were based on census block group geography.

Base year 2010 demographic data was developed from the following sources:

- Household information was based on the 2010 Census data, and
- Employment information was based on the Longitudinal Household-Employer Dynamics (LEHD) origin-destination employment statistics.

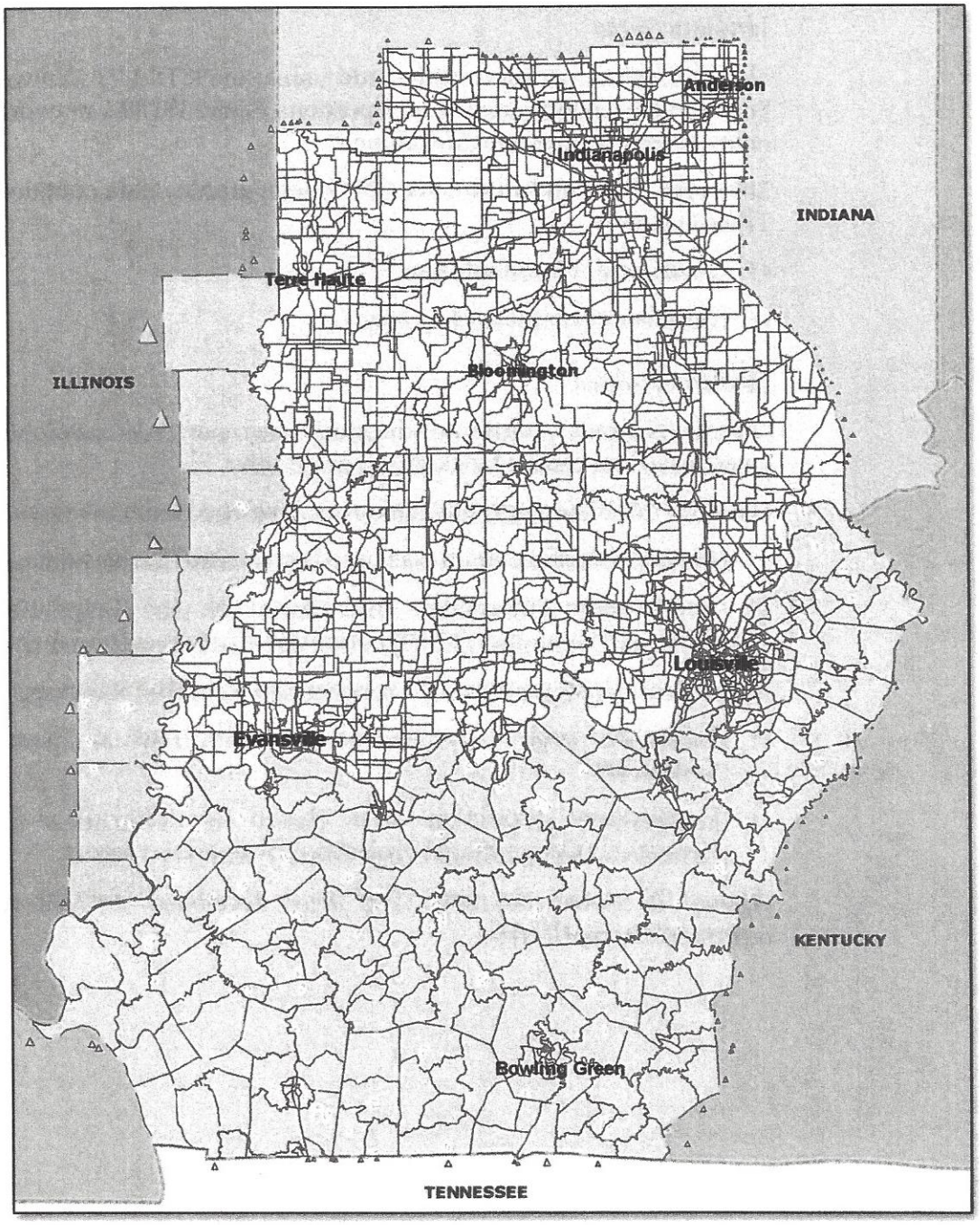
Future year demographic data was obtained from the following sources:

- Household projections were based on data from the Kentucky State Data Center, and
- Employment projections were based on information from Workforce Kentucky's Occupational Projections by analysis district.

Figure 3.2 shows the final TAZ layer developed for this study. Triangles represent external TAZs.

[1] Indiana Statewide Travel Demand Model Upgrade; Indiana Department of Transportation, March 2005

Figure 3.2 Study Area TAZ Layer



Development of Base Year Trip Table

Freight Trucks

Base year freight truck origin-destination (O-D) trips were developed from the Freight Analysis Framework (FAF) national model. County to county trips were assigned to the national model and trips into, out of, within and through the I-67 study area were retained. These trips constitute the base year I-67 Model trip tables for freight trucks.

Autos

Since there is no model that covers the entire study area from which a trip table could be used to develop the base year auto flows, the approach that was taken involved bringing together O-D information from different sources and adjusting it based on observed traffic flow data. The general process is described below and is outlined in Figure 3.3:

1. **Develop base year auto "seed" trip table.** The first priority was to develop a "seed" trip table, or first iteration of the trip table, that expresses the trip patterns correctly. To the extent possible, O-D information from the ISTDM was used. For the O-D pairs within the study area that did not have an ISTDM equivalent, trip patterns from the Corridor 18 model, from the Corridor 18 Feasibility Study, were used.
2. **Normalize auto trip tables.** Trip-ends (the number of trip origins or destinations at a particular zone) were adjusted based on trip generation models borrowed from the ISTDM.
3. **Calibrate auto trip tables.** Origin Destination Matrix Estimation (ODME) techniques were then used to refine these trip tables in order to better match the observed traffic count data.

Non-Freight Trucks

The process to develop non-freight truck trips is nearly identical to that for the autos. The difference lies in the development of the initial seed trip table which was developed by combining the O-D patterns from the FAF truck trip tables and the initial "seed" auto trip tables described above:

1. **Develop base year non-freight truck "seed" trip table.** O-D information from the initial "seed" auto trip tables and the FAF truck trip tables were combined to create this first iteration of the non-freight truck trip tables.
2. **Normalize non-freight truck trip tables.** Trip-ends (the number of trip origins or destinations at a particular zone) were adjusted based on trip generation models borrowed from the ISTDM.

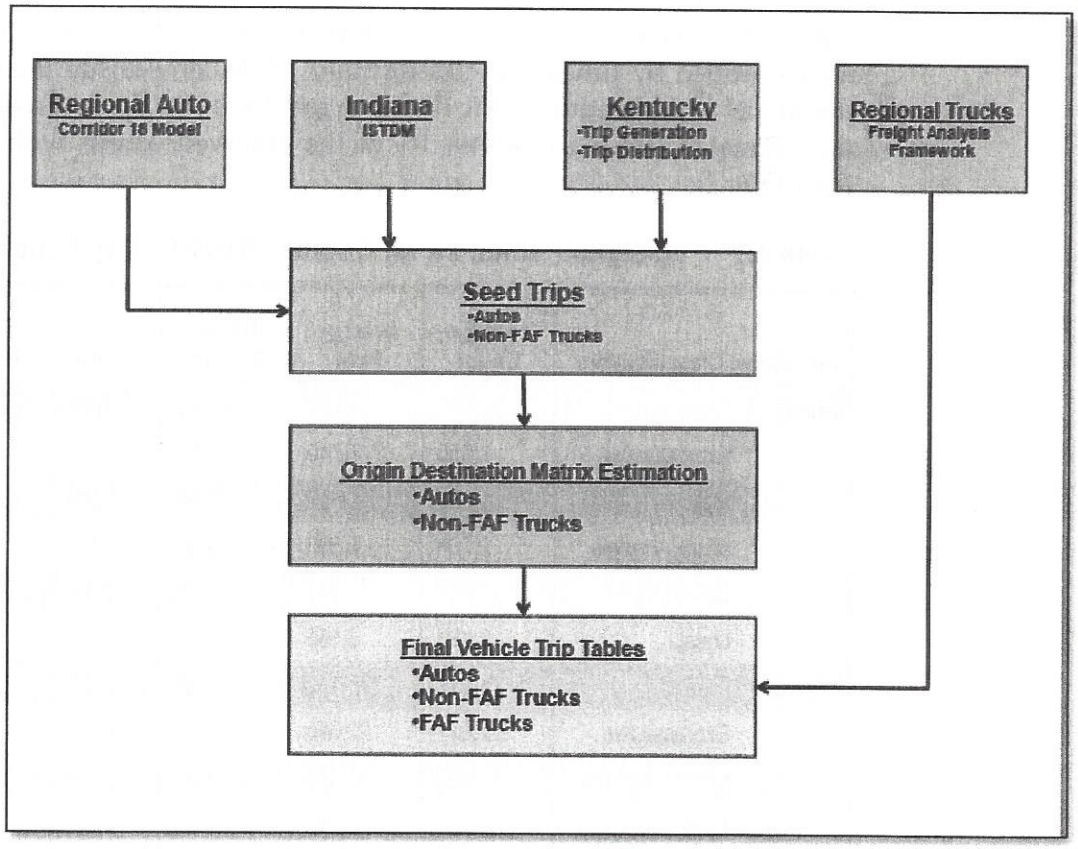
3. **Calibrate non-freight truck trip tables.** ODME techniques were then used to refine these trip tables in order to better match the observed traffic count data.

Base Year Trip Table Calibration

The ODME procedure within TransCAD, a travel demand forecasting software package, was used to iterate between the traffic assignment and matrix estimation stages; the main objective is to refine the initial O-D vehicle matrices from the seed trip tables to better match the observed data. The procedure is based on the Maximum Likelihood technique, which attempts to estimate a trip table that maximizes the probability of all input datasets.

The input datasets include an initial estimate of the O-D matrices as described above and Automatic Traffic Recorder (ATR) data. The procedure is Multimodal and Multi-Class (MMA), and the MMA O-D Matrix Estimator is based on TransCAD's MMA assignment procedure. The MMA assignment routine is a generalized cost assignment that assigns trips by individual mode or user class to the network simultaneously. Each mode or class can have different congestion impacts, different volume delay function parameters, different values of time, and different sets of excluded facilities and types of tolls. The advantage of using the MMA Assignment for ODME is that rather than producing just one overall trip O-D matrix, the MMA ODME can generate estimated trip matrices for each mode or class.

Figure 3.3 Trip Table Development Process



The determination as to which vehicle trip tables to estimate using ODME was based on the study objectives and the availability of the count data. A successful implementation of the multimodal approach requires multimodal count data. A review of the count data revealed that the classification scheme that yielded the most data points was broken into two groups: truck and non-truck. The non-truck group included all vehicle types not classified as a truck in the counts. As the truck group does not distinguish between freight and non-freight based trucks, the approach was to develop count targets for non-freight trucks by first assigning the FAF freight trucks and then calculating the non-freight targets by subtracting the assigned freight trucks from the overall truck counts. Then the MMA ODME procedure consisted of preloading the freight trucks and performing the ODME for the auto and non-freight trucks.

O-D Validation Criteria

There currently is no consensus on criteria for determining when an O-D table produces traffic flows that are considered validated. For this study, common measures of travel demand assignment validation as recognized by FHWA were used to compare the assigned volumes to observed traffic counts. These include

the percent deviation between the counts and assigned volumes, the percent Root Mean Square Error (%RMSE) of these deviations, and screenline analysis.

Table 3.1 compares estimated traffic flows to observed counts for the entire study area stratified by functional classification. This comparison indicates how well the model is replicating traffic flows on the different types of roadways. Overall the estimated flows are within 1% of the observed counts with a %RMSE less than 15%.

Table 3.1 Assigned Volumes vs. Counts - Stratified by Functional Class

Functional Classification		Average Count	Average Flow	No. of Counts	% Dev	FHWA Standard	% RMSE
Rural	Freeways	34,548	34,247	47	-0.9%	+/- 7%	5.1%
	Expressways	7,658	7,740	551	1.1%	+/- 7%	9.7%
	Major Arterials	5,629	5,683	661	1.0%	+/- 10%	13.4%
	Minor Arterials	2,788	2,803	1,868	0.5%	+/- 15%	14.1%
	Collectors	1,814	1,847	69	1.8%	+/- 25%	15.0%
	Local	2,193	2,166	8	-1.2%	N/A	9.8%
Urban	Freeways	71,277	71,145	54	-0.2%	+/- 7%	7.3%
	Expressways	22,877	22,696	29	-0.8%	+/- 7%	5.3%
	Major Arterials	17,520	17,158	631	-2.1%	+/- 10%	9.1%
	Minor Arterials	9,611	9,303	354	-3.2%	+/- 15%	8.9%
	Collectors	6,347	6,129	103	-3.4%	+/- 25%	13.2%
	Local	1,631	1,724	1	5.7%	N/A	5.7%
	Other	7,247	7,284	49	0.5%	N/A	34.5%
Total		7,886	7,824	4,425	-0.8%	N/A	13.3%

Table 3.2 compares estimated traffic flows to observed counts for the entire study area, stratified by volume group. This indicates how well the model replicates observed counts with regard to the level of traffic on the facility. Generally, it is desirable for the higher volume roadways to match more closely than the lower volume roadways as they carry the majority of traffic. Table 3.2 shows that as the average roadway volumes increase, the percent deviation and percent RMSE generally improve.

Two screenlines were developed to get a sense of how well the model matches the observed data with regard to regional O-D patterns. One measures the traffic crossing the Ohio River to capture north/south movements, and the other measures traffic traveling east/west or west to east across Kentucky to capture any changes in route choice related to the project. Figure 3.4 shows the location of the screenlines. Base year traffic forecasts were compared to observed count

data and appear in Table 3.3 below. Traffic estimates across both screenlines are within 2% of the observed daily traffic.

Table 3.2 Assigned Volumes vs. Counts - Stratified by Volume Group

Volume Group	Average Count	Average Flow	No. of Counts	% Dev	% RMSE
0-1,000	596	632	474	6.0%	24.9%
1,000-2,500	1,708	1,768	924	3.5%	18.7%
2,500-5,000	3,690	3,720	1,087	0.8%	13.8%
5,000-10,000	7,103	7,051	924	-0.7%	10.4%
10,000-25,000	15,122	14,779	759	-2.3%	8.9%
25,000-50,000	33,870	33,669	209	-0.6%	6.8%
>50,000	81,303	80,729	48	-0.7%	6.9%
Grand Total	**7,886**	**7,824**	**4,425**	**-0.8%**	**13.3%**

Figure 3.4 Screenline Locations

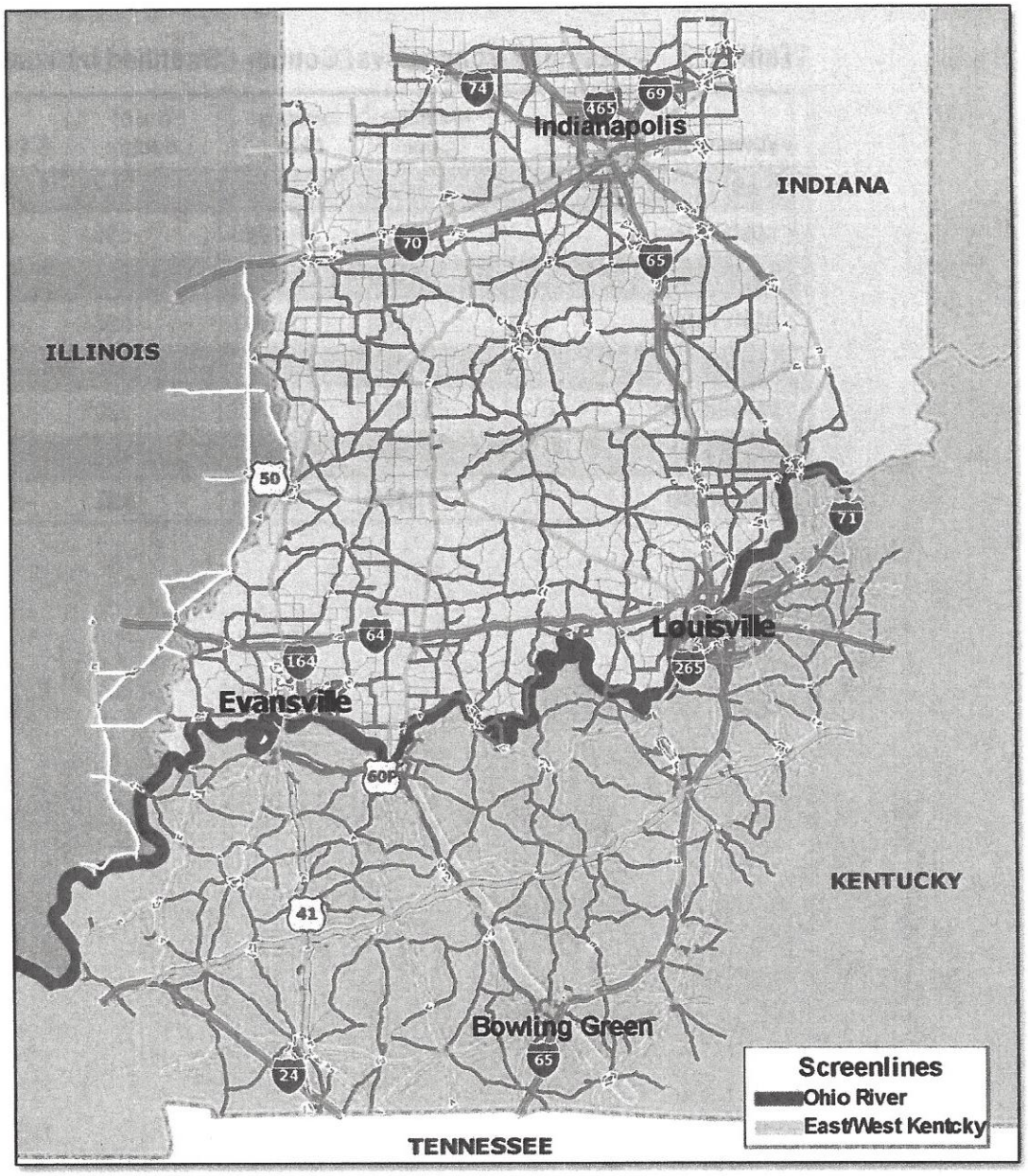


Table 3.3 Modeled Traffic Volumes vs. Observed Traffic Counts - Screenlines

Screenlines	Average Observed Counts	Average Modeled Volumes	No. of Counts	% Devation	% RMSE
Ohio River	31,044	31,328	10	0.9%	5.9%
East/West Kentucky	11,121	10,921	13	-1.8%	21.0%

3.2 FORECASTING APPROACH

Future year growth for auto, non-freight truck, and freight truck trips was estimated for each TAZ individually. This was accomplished by applying trip generation rates from the ISTDM to the base and future year demographic data for each TAZ to generate total trip ends (trips originating or terminating in a TAZ). Growth factors were then developed from the ratio of future year trip ends to base year trip ends. These growth factors were applied using a Fratar process to the validated base year trip table to produce future year trips. A Fratar process is standard means of using growth factors to extrapolate a trip table to a future year. The future year trips were then assigned to the future year networks for the following scenarios:

- **Year 2035 No Build.** All committed roadway projects for Indiana and Kentucky were added to the existing base year network. Network assumptions included:
  - Network improvements consistent with INDOT's Existing Plus Committed (E+C) scenario, as reviewed by INDOT.
  - System upgrades and improvements consistent with the Kentucky Transportation Cabinet's Six Year Highway Plan.
- **Year 2035 Build (No I-67 Toll).** Implementation of I-67 between Bowling Green, KY and Washington, IN as described in Section 1. The model reflects new construction for I-67 along a corridor from I-64 and US-231 to I-69 at Washington, IN, and minor improvements throughout the rest of the existing corridor.
- **Year 2035 Build (I-67 Toll).** New sections of I-67 from north of I-64 and US-231 to I-69 in Washington, IN, were tolled using:
  - Distance based tolls, derived from averages of existing toll rates on the Indiana Toll Road and most recent rates on Kentucky's previously tolled facilities (adjusted for inflation), of:
    - » $0.03 per mile for autos
    - » $0.05 per mile for non-freight trucks
    - » $0.15 per mile for freight trucks
  - Value of time (VOT) parameters developed for the Illiana Expressway Feasibility Study:
    - » Autos at $15.02 per hour[2]

[2] The Illiana study stratified auto value of time among work and non-work trips. The value used for this study is for autos only and is a weighted average of the work and non-work values.

» Non-freight trucks at $26.74 per hour

» Freight trucks at $31.12 per hour

The toll rates used in the analysis are not recommended toll rates, and a complete analysis of traffic and financial impacts under various toll scenarios was not performed. The purpose of the toll scenario is to generally test the sensitivity of traffic to a moderate toll rate, and estimate potential revenues.

3.3 MODEL RESULTS

System-Wide

Tables 3.4 through 3.5 compare system-wide statistics for the model area related to the assignment of base and future year trips to the network. The first table compares vehicle miles travelled (VMT) and the second reports vehicle hours traveled (VHT), both by functional classification of roadway and area type (urban or rural). These statistics represent the roadway links contained within the model network, and not every local roadway actually in the model area is contained within the model. These measures together describe the performance of the different scenarios with respect to one another. These comparisons show:

- Average speeds are highest in the base year as there is less traffic than in future years:
  - VMT is estimated to increase by 34% in 25 years; and
  - VHT is estimated to increase by 37%.
- Overall VMT is highest for the build alternative without tolls as traffic shifts to I-67, sometimes driving longer distances in order to reduce total travel time.
- Overall VHT is lowest for the build alternative without tolls, and therefore average speeds (calculated as VMT/VHT) increase slightly in this alternative as traffic shifts away from more congested routes to the new, uncongested facility.
- Adding tolls shifts some of the traffic away from the new facility as compared to the build alternative without tolls, resulting in slightly lower VMT, slightly higher VHT and slightly lower resulting speeds system-wide.

Table 3.4 System-Wide Vehicle Miles Traveled

FC		2010 Base	2035 NB	2035 Build	2035 Build (Tolled)
Rural	Freeways	20,573,673	31,641,973	31,641,292	31,598,754
	Expressways	14,965,066	20,365,350	21,263,876	20,889,711
	Major Arterials	10,567,848	14,435,571	14,287,449	14,395,061
	Minor Arterials	17,059,377	24,097,977	23,706,776	23,784,713
	Collectors	1,007,971	1,562,748	1,558,346	1,560,996
	Local	47,702	61,302	61,892	61,803
Urban	Freeways	24,750,181	31,653,189	31,553,221	31,587,101
	Expressways	1,917,087	2,428,351	2,376,262	2,346,705
	Major Arterials	20,027,889	25,275,423	25,292,034	25,318,105
	Minor Arterials	8,732,542	10,970,154	11,005,814	11,000,644
	Collectors	1,644,855	2,295,914	2,278,653	2,291,233
	Local	6,985	9,406	9,415	9,405
	All	121,301,177	164,832,665	165,070,330	164,879,536

Table 3.5 System-Wide Vehicle Hours Traveled

FC		2010 Base	2035 NB	2035 Build	2035 Build (Tolled)
Rural	Freeways	300,909	481,573	479,323	480,424
	Expressways	262,723	354,130	364,571	359,570
	Major Arterials	203,847	288,997	286,027	288,481
	Minor Arterials	351,417	513,801	505,802	507,215
	Collectors	23,401	39,246	39,286	39,175
	Local	1,033	1,341	1,356	1,354
Urban	Freeways	444,001	594,472	590,033	592,207
	Expressways	33,076	41,748	40,939	40,591
	Major Arterials	523,601	694,084	691,796	694,276
	Minor Arterials	257,383	348,127	349,921	349,283
	Collectors	49,787	72,574	71,712	72,290
	Local	222	332	332	331
	All	2,451,400	3,431,072	3,421,742	3,425,844

Screenlines

A comparison of traffic at the screenlines can show how regional traffic diverts in response to the availability of new capacity. Tables 3.6 and 3.7 show the traffic at each of the roadways that are part of the two screenlines developed for this study.

The Ohio River screenline captures how traffic routes itself across the river:

- Overall, traffic crossing the Ohio River is estimated to increase by about 30% from 2010 to 2035.
- With the opening of I-69, traffic shifts from US-41 to I-69; 2010 base year flows on US-41 drop from about 43,000 to about 39,000 and traffic on the new I-69 bridge is estimated to be about 13,000.
- Similarly, with the opening of the Eastside Bridge in Louisville, traffic shifts to the new bridge away from the I-65 bridge; 2010 flows on I-65 drop from about 136,000 in 2010 to about 106,000 in 2035 and traffic on the new Eastside Bridge is estimated to be about 66,000.
- In the build alternative without tolls, regional traffic is estimated to shift slightly from the I-65 corridor to the new I-67 corridor; traffic on bridges in Louisville drops slightly and traffic on the US-231 (I-67 in the build scenario) bridge increases slightly.
- The addition of tolls to the I-67 facility shifts some of the traffic back from the I-67 corridor to the I-65 corridor; US-231 bridge traffic flows are slightly lower with a tolled I-67 than without tolls; the Louisville bridges in general have slightly higher volumes; and I-69 remains the same.

Table 3.6 Ohio River Screenline

Route	2010 Traffic Count	2010 Base Volume	2035 No Build	2035 Build	2035 Build (Tolled)
IL-1/KY-91	1,800	1,900	2,000	2,000	2,000
US-41	44,000	42,900	38,900	38,900	38,900
I-69	N/A	N/A	13,300	12,900	12,900
IN-161/J.R. Miller Blvd.	7,300	7,600	6,700	6,600	6,600
US-231 (I-67)	5,900	6,900	20,800	24,900	22,200
IN-237/KY-69	8,900	9,400	8,500	8,400	8,500
IN-135/KY-79	5,300	5,400	8,600	8,000	8,600
I-64	79,000	83,300	107,800	107,300	107,200
Clark Memorial Bridge	15,900	13,000	23,500	22,600	23,400
I-65	134,000	135,600	105,600	103,800	104,600
New Eastside Bridge	N/A	N/A	66,100	65,800	66,600
US-421	8,300	8,400	6,000	6,000	6,000
Total	310,400	314,400	407,800	407,200	407,500

The Kentucky east/west screenline captures traffic that travels eastward and westward between the two main north-south corridors between which diversion of longer trips could occur: I-65 and I-67. The comparison of traffic on the roadways that are part of this screenline show:

- Traffic increases on US-231 (I-67 in the build scenario) near Owensboro under the two build alternatives from about 27,000 in the no build to about 31,200 without tolls on I-67 and about 28,500 with tolls on I-67.
- Traffic on I-65 near Bowling Green is estimated to decrease slightly under the two build scenarios from about 93,900 in the no build to about 91,500 without tolls on I-67 and about 93,200 with tolls on I-67 as regional traffic shifts away from the I-65 corridor to the new I-67 corridor.

Table 3.7 Kentucky East/West Screenline

Route	2010 Traffic Count	2010 Base Volume	2035 No Build	2035 Build	2035 Build (Tolled)
US-60	30,600	23,200	8,700	8,800	8,700
New US 231 (I-67)	N/A	N/A	27,000	31,200	28,500
Leitchfield Road	18,700	18,400	20,100	20,100	20,100
KY-69	5,200	4,800	5,400	5,400	5,400
US-62	2,600	2,700	3,100	3,100	3,100
Wendall Ford Pkwy	7,200	9,700	15,900	15,800	15,800
KY-79	3,000	3,900	7,200	6,300	7,000
KY-70	2,200	2,800	3,800	3,800	3,800
KY-185	2,600	2,200	4,000	4,000	4,000
US-68	18,200	19,300	18,600	18,600	18,600
I-65	47,300	45,500	93,900	91,500	93,200
KY-101	1,000	2,300	5,300	5,000	5,000
US-31E	4,600	5,100	10,400	10,400	10,400
KY-98	1,400	2,100	3,600	3,600	3,600
Total	144,600	142,000	227,000	227,600	227,300

Traffic Diversions

The tables above indicate that with the addition of capacity to the I-67 corridor under the build alternatives, some regional traffic can be expected to divert away from the I-65 corridor. They also indicate that the addition of tolls tempers the regional demand for the new I-67 corridor and some of the traffic can be expected to shift back to the I-65 corridor. To illustrate these dynamics, difference plots were developed that compare one-way traffic volumes between scenarios.

Figure 3.5 shows how traffic shifts to other routes under the build scenario without tolls from the no build scenario condition. In addition to regional shifts from I-65 to I-67, locally traffic diverts to the new I-67 facility away from existing US-231 and from other local roads parallel to the new facility in Indiana.